

Anesthesia

Pre-Operative Medications

-It includes psychological and pharmacologic components.

-The drugs used in the preoperative visit are used with one or more of the following **goals**:

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|--------------------------------------|---|-----------------------------------|------------|--|
| 1- Sedation | 2- Anxiolysis | 3- Analgesia | 4- Amnesia | 5- Antisialagogue (drying of secretions) |
| 6- Prevention of allergic phenomena. | 7- Reduction of vagal activity | 8- Decrease gastric fluid volume. | | |
| 9- Increase gastric pH | 10- Attenuate stress response | 11- Prevent nausea and vomiting | | |
| 12- Decrease anesthetic requirements | 13- Facilitation of anesthetic induction. | 14- Antihistamines. | | |

**Caution should be exercised when administering premedicants to certain patients:*

- Pediatric patients under 1 year of age.
- Geriatric patients.
- Patients with intracranial pathology.
- Critically ill or hypovolemic patients.
- Cardiac patients: with dysrhythmias or myocardial infarction.

Commonly used preanesthetic drugs:

1- Benzodiazepines:

- They are useful for anxiolysis, sedation and amnesia.
- They have a high therapeutic index with minimal cardiorespiratory depression.
- Disadvantages*: excessive and prolonged sedation, pain on injection.

a) Diazepam (Valium):

- Effective premedicant with good sedative, anxiolytic, and amnesic properties.
- Better given orally as parenteral injection may cause phlebitis and pain.

b) Lorazepam (Ativan):

- 5-10 x more potent than diazepam
- Produces heavy sedation and reliable amnesia
- Has long duration of action (half-life 10-20 hr.)
- Does not produce phlebitis or pain on injection

c) Midazolam (Dormicum):

- Has 3-4 times the potency of diazepam.
- Water soluble, rapidly metabolized (half-life of 1-4 hr.)
- Displays very good sedative & amnesic properties.

2- Barbiturates:

- Secobarbital and pentobarbital are occasionally used.
- They provide reliable and safe sedation, but are not as specifically anxiolytic as benzodiazepines.
- Effective when administered orally.
- *Disadvantages*: lack of analgesia, disorientation, absence of specific antagonist, stimulation of hepatic microsomal enzymes.
- *Contraindicated* in porphyria → acute exacerbation.

3- Opioids:

- They are used for premedications when analgesia is needed e.g. a patient with a painful condition or one who will require potentially painful monitoring lines or regional anesthetic techniques.
- Absence of direct myocardial depression.
- Can be administered through different routes: oral, IM, IV, spinal, rectal, transnasal, transdermal, transmucosal and lolly pop (for pediatrics).

• Side Effects of Opioids:

- | | | | |
|--|---------------------------|---------------------|----------------------|
| - Respiratory depression | - Nausea and vomiting | - Urinary retention | - Excessive sedation |
| - Potential for choledochoduodenal sphincter spasm | - Orthostatic hypotension | - Pruritus | |
| - Bradycardia | - Constipation | - Delayed recovery | |

a) Morphine:

- Best given preoperatively IM (0.1 mg/kg) - Peak effect in 30-45 min. and duration of action about 4 hr.
- Can be given by other routes IV, orally or suppository.
- Caution is advised in the elderly, and O₂ supplementation is advised.

b) Meperidine:

- Given preoperatively intramuscular 1 mg/kg - Peak effect in 1 hour, duration of action 2-4 hr.
- Similar in structure to atropine thereby may cause tachycardia.

4- Anticholinergics:

Most commonly used preoperatively to dry oral secretions, prevent vagally mediated bradycardia especially in pediatrics and production of sedative & amnesic effect.

- They are not effective in ↑ gastric pH or ↓ gastric volume.
- *Disadvantages:* CNS toxicity, tachycardia, mydriasis & cycloplegia, ↑ body T°, drying of airway secretions, relaxation of lower esophageal sphincter and ↑ physiologic dead space.

5- Prophylaxis against aspiration pneumonitis:

- Many patients presenting for operation may be at increased risk for regurgitation and aspiration of gastric contents: e.g. parturient, obese, patients' with difficult airway & gastroesophageal reflux.
- The risk of adverse pulmonary sequelae is greater when:
 - Gastric volume is greater than 25 ml (0.4 ml/kg).
 - pH is less than 2.5
- The patient should be fasting for 6-8 hr.

a) Cimetidine:

- An H₂ receptor antagonist
- Given the night before and the morning of surgery to produce a reliable increase in gastric pH.

b) Ranitidine:

- Has a lower incidence of side effects than cimetidine.

c) Famotidine:

- A newer H₂ receptor antagonist. . - Duration of action is 10 - 12 hr.

d) Metoclopramide:

- A dopaminergic antagonist that stimulates gastric motility speeding gastric emptying.
- It increases the tone of the lower esophageal sphincter
- It has no effect on gastric fluid pH, an H₂ antagonist should be used
- Its side effects include extrapyramidal syndrome.

e) Non-particulate antacids:

- Like sodium citrate which is effective in immediately increasing gastric pH.

Intravenous Anesthetics

Properties of ideal IV anesthetic agent:

1. Rapid onset, resulting in smooth and rapid induction.
2. Rapid recovery, especially for outpatient use, e.g. in the dental clinic.
3. Produces analgesia in smaller doses.
4. Minimal or no cardiovascular or respiratory depression.
5. Not emetic.
6. No excitatory effect e.g. coughing, hiccup or involuntary movement.
7. No emergence phenomenas, e.g. nightmares.
8. No pain on injection or venous sequelae and safe if it enters an artery by accident
9. No toxic effects, histamine release or hypersensitivity reactions.
10. Water soluble and long shelf life.
11. No stimulation of parasympathetic.
12. Not cumulative.

1. Thiopentone Sodium

-The sulphus analogue of pentobarbitone, dissolved in distilled water to produce 2.5% solution with pH 10.8. The dose in adults and children is 5-7mg/kg, in the elderly only 3mg/kg. In adults, 2ml are given first and the patient is asked about the presence of any local pain to avoid intra-arterial injection before giving the rest of the dose.

-Induction is smooth, side effects are related to peak blood conc., thus if there is risk of C.V depression, it should be given "very slowly". Supplementary doses may be given to prolong the time of G.A. for short surgical procedures, but if large doses are given, recovery will be markedly prolonged due to its cumulative effect.

Pharmacological Effects:

1. Progressive C.N.S depression, ending in G.A for a few 'minutes for the single dose.
2. Potent hypnotic but poor analgesic action.
3. Consciousness regained in 5-10 min.
4. Potent anticonvulsant, thus useful in treatment of epileptic attacks and toxicity from L.A
5. Depresses on both sympathetic and parasympathetic systems, thus bradycardia may develop, but more often tachycardia occurs due to the modest hypotension that usually results.
6. On C.V.S.: depressed myocardial contractility and peripheral V.D. will result in hypotension that may be profound if a large dose is rapidly injected, especially in presence of added hypovolemia or cardiac disease.
7. On respiration: Causes ventilatory depression and a short period of apnea is common, usually preceded by few deep breaths.
 - Respiratory depression is more common in premeditated patients, especially with opioids and may need assisted or controlled ventilation to treat.
 - Bronchospasm is common but laryngospasm may be started by surgical stimulation or the presence of secretions or blood in an airway.
8. On skeletal muscles: Tone is depressed but muscle relaxation is poor, resulting in response to surgical stimulation
9. Uterine contractions only suppressed with large doses. it crosses the placental barrier, but foetal blood conc., is less than that of the mother,
10. On the eye: The Intra-ocular pressure is reduced, while the pupils first dilate then constrict with surgical anesthesia
11. Hepatorenal functions: Impaired transiently.

Side Effects:

1. Hypotension: more with large doses, hypovolemic, shocked or hypertensive patients. Risk is reduced by giving the drug slowly and never with patient sitting and avoid high dosage.
2. Respiratory depression, bronchospasm and laryngospasm treated by assisted or controlled ventilation and bronchodilator.
3. Local tissue necrosis: due to perivenous injection of this very alkaline solution. In the antecubital fossa. The median nerve may be damaged. If that happens, leave the needle in place and inject hyaluronidase, xylocaine for pain and hot fomentations; do not use 5% sol. & avoid using antecubital fossa for injection.
4. Thrombophlebitis: Uncommon, but occurs more with 5% solution
- 5, Allergic reactions: Range from skin rash to fatal anaphylactic shock with C. V collapse. (very rare) avoided by sensitivity tests.
6. Intra-arterial injection: due to inadvertent injection in the brachial or aberrant ulnar artery in the antecubital fossa.
 - Intense pain results "stop the injection at once", the forearm and hand become blanched and distal blisters may appear.
 - There is profound spasm of the artery with local release of adrenaline, this together with endarteritis and platelet emboli and damaged red cells will cause thrombosis of the artery resulting in ischaemia and maybe gangrene in parts of the forearm bands or fingers.
 - Managed by leaving the needle in the artery and give a vasodilator-like papaverine 20mg and xylocaine around the artery to reduce pain and spasm.
 - Stellate ganglion or brachial plexus block will also help to promote peripheral vasodilation, heparin given I.V. and oral anticoagulants given later and remove thrombus from artery if possible, prophylactically avoided by careful I.V. technique, avoid the antecubital fossa, draw blood first to ensure vein (dark blood, not under pressure arterial blood is bright red and under pressure). Give few test drops first and avoid using 5% solution of the drug.

2- Ketamine Hydrochloride

-Phencyclidine derivative, that produces dissociative anaesthesia, rather than the generalized C.N.S depression produced by other anaesthetic agents. Available as isotonic sol. of pH 3.5-5.5. containing 10, 50 or 100 mg/ml Given IV., it induces anaesthesia in 30-60 sec., while unconsciousness lasts 10-15 min. If given I.M. it acts in 3-4 min. and lasts for 15-25 min. It is a potent analgesic and produces amnesia for up to 1hr after recovery.

-Induction of G.A is smooth but emergence delirium may occur with restlessness, disorientation and agitation with vivid and often unpleasant nightmares or hallucinations that may last for up to 24 hrs. These reactions can be reduced by avoiding verbal and tactile contact with the patient during recovery and the use of narcotic or tranquilizer premedications. These reactions are less frequent in children or the elderly. It also increases cerebral blood flow and intra-cranial pressure.

-On C. V.S.: it increases the blood pressure and heart rate and cardiac output, with increased myocardial sensitivity to adrenaline. On respiration: Transient apnea followed by normal ventilation with maintained pharyngeal and laryngeal reflexes and a patent airway, but not always. Also salivary secretion is excessive and bronchial muscles dilated. Muscle tone increased and spontaneous movement may occur. It crosses the placental barrier to the foetus. It increases the intra-ocular pr. and eyeball movement may persist during surgical anaesthesia

-Dose is 2mg/kg IV slowly, additional 1-1.5 mg/kg every 5-10 min. The IM dose is 8-10 mg/kg, while the analgesic dose is 0.25-0.5mg/kg or an infusion of 50 µg/kg/min. without loss of consciousness.

Useful drug in shocked patients and since most of these patients are heavily sedated post-operatively, the risk of nightmares is minimized. Also in pediatric surgery, given IV or IM, Also, management of trauma in difficult locations as anaesthesia or analgesia which can also be used for painful procedures as wound dressings. Contraindicated in:

1. Airway obstruction
2. Hypertensive patients with ischaemic heart disease.
3. Raised intracranial tension.

The prolonged recovery and emergence reactions make unsuitable for outpatient surgery in adults.

Hazards and Complications of Anesthesia

I) Neurosurgical Complications:

1- Cerebral Hypoxia:

- Hypoxic hypoxia*: may result from: ▪ Reduced O₂ percentage in the inhaled gas mixture. ▪ Respiratory obst.
- Diffusion hypoxia*: in a case of pulmonary edema. -*Stagnant hypoxia*: in peripheral circulatory failure.
- Histotoxic hypoxia*: in poisoning.

The clinical picture of cerebral hypoxia:

- Mild cerebral hypoxia can cause delayed recovery.
- Sever hypoxia can give rise to a personality changes which may turn the normal person into idiot.
- Gross hypoxia can cause coma and death.

Factors affect the outcome of cerebral hypoxia:

- A- Associated circulatory failure. B- The presence of cerebral disease.

Treatment:

- Ventilation (positive pressure) of the lung with 100% O₂
- Dehydrating measures & steroids for treatment of oedema.
- Hypothermia to reduce the O₂ requirement - Correction of fluid balance.

2- Peripheral nerve palsy:

Causes:

- a. *Over stretching* e.g. mal positioning esp.of the upper arm, severe abduction may → brachial plexus palsy.
- b. *Compression* of the nerve at the sharp edge of the operating table may lead to ulnar nerve palsy.
- c. *Injection*: damage of the nerve by the tip of a needle e.g. median nerve palsy.

3- Convulsions:

May occur after local analgesia or general anesthesia predisposing factors include:

- Age: More vulnerable in children than adult. - Diseases: Sepsis and hyperpyrexia.
- Pain - Toxicity of local analgesics.

II) Cardiovascular complications:

Cardiovascular instability: This includes: Hypertension, hypotension and cardiac dysrthmias.

a- Acute hypertension: The most common causes are:

1. Light plane of anesthesia & inadequate analgesia, there is associated lacrimation, sweating, tachycardia.
2. Hypercarbia (CO₂ accumulation) due to inadequate ventilation.
3. Undiagnosed pheochromocytoma. 4. Drugs: Most anesthetic drugs cause hypotension.

b- Acute hypotension: May result from surgical or anesthetic-causes:

• Surgical causes:

- Sudden changes in positions: anti-trendlenburg, prone or lateral positions may cause hypotension.
- Major blood loss especially in extremes of age.
- Surgical manipulations: e.g. surgical procedures at carotid body region, hilum of the lung, gall bladder, stretch or dilatation of urethra, anus or cervix.
- Following the release of tourniquet or clamps on a major vessel (release of metabolic products in the general circulation and its effect is vasodilatation).

• Anesthetic causes:

- Overdose of anesthetic drugs, premedicants, intravenous inhalation anesthetics and also local analgesica.
- Late stage of hypoxia and hypercarbia.
- Excessive positive pressure ventilation of the lungs impedes venous return with the resultant low COP.

c- Cardiac dysrhythmias:

Causes:

- Anesthetic agents especially halogenated anesthetics, they sensitize the myocardium to the action of circulating catecholamines.
- Hypoxia, hypercarbia and hypotension. - Surgical manipulations.
- Cardiac patients are esp. susceptible.

III) Respiratory complications:

1. Respiratory obstruction:

It can occur at any level of the respiratory tract:

A- In the pharynx:

The commonest site in non-intubating patient. The jaw relaxes as consciousness is lost and the tongue falls back against the posterior pharyngeal wall.

Correction by holding the jaw forwards and inserting an airway.

B- In the larynx:

1- *Spasm*: direct laryngeal spasm arises from irritation of the cords by too strong anesthetic vapour, or by saliva or vomit. Reflex spasm can arise from a stimulus from the operative site esp. under light anesthesia.

-Treatment by pure oxygen and remove the cause of spasm.

-In severe cases intubation of trachea may be indicated with the aid of short acting muscle relaxant.

2- *Tumours*: may cause complete obstruction when the cords relax under anesthesia preoperative signs of obstruction are indication for trachea stomy under local analgesia.

C-In the trachea and branch:

Profuse secretion, sputum, foreign bodies or vomit obstruct and the bronchial tree. These must be cleared by suction and the lungs filled with O₂. Bronchoscopy may be necessary. Bronchospasm (bronchial asthma) is another cause of respiratory obstruction and should receive immediate treatment.

D- In the alveoli:

Pulmonary oedema, as in heart failure, leads to impaired diffusion across the alveoli.

Signs of respiratory obstruction:

- With spontaneous respiration: noisy breathing, absent breath sounds, diminished chest movement, forced expiration or paradoxical chest movement.
- With controlled respiration: increase in pressure required to inflate the lungs.
- Signs due to hypoxia and hypercarbia: cyanosis, tachycardia, sweating and hypertension.

2. Respiratory depression:

This can result from:

- Drugs: analgesics, overdose of anesthetics, muscle relaxants.
- Diseases: as metabolic disorders (uraemia, diabetes), cerebral haemorrhage.
- Extremes of temperature: hypothermia.

3. Postoperative pulmonary complications:

Tracheitis, bronchitis, bronchopneumonia, lung abscess & pulmonary collapse,

The predisposing factors are

- Pre-existing lung disease.
- Site of operation: high incidence in upper abdominal operation.
- Anesthetic drugs and techniques with insufficient ventilation will increase the risk.

IV- Vomiting and regurgitation:

Stomach contents can reach the pharynx and inhaled by two quite different mechanisms.

1. By active vomiting during induction with intravenous or with inhalation agents.
2. By passive regurgitation as a result of relaxation occurring under muscle relaxants or deep GA.

Factors contributing to vomiting and regurgitation:

- a. A high intragastric pressure, e.g. full stomach.
- b. A high intraabdominal pressure, e.g. distended abdomen, ascites or tumours.
3. Obstruction of airway.
4. Intra-abdominal manipulation.
5. Hypoxia.

Both vomiting and regurgitation produce irritation and inflammation of the lungs up to severe hypoxia which leads to cardiac arrest. Latter on infective sequelae as bronchopneumonia & lung abscess can occur.

Prevention:

1. Empty stomach: Is the important preventive measure:

- a. In elective operations: the patient should be NPO for at least 4 hours.
- b. In emergency situations: A large stomach tube is passed before induction to reduce the volume of stomach contents.

2. Measure during induction:

- a. Inhalation induction must be smoothly done with head down and to one side so that vomitus will flow away from the larynx. This is to be followed by intubation with a cuffed tube.
- b. Intubation under muscle relaxation may lead to passive regurgitation so tilt head-up to offer protection by gravity.

3. After operation:

- Careful suction is essential, the Trendelenburg position is always adopted when there is a possibility of blood, secretion or vomitus to enter the tracheobronchial tree.

Treatment:

- If vomiting occurs, immediately put the patient in the head down position, perform suction and give O₂, bronchoscopy and bronchial toilet as sometimes advisable.
- Hydrocortisone to combat bronchial spasm and antibiotics to prevent the subsequent bronchopneumonic changes.

Subarachnoid Block

Effects of S.A.B:

A- Nervous system:

S.A.B. produces paralysis of the nerve fibres in this order: First sympathetic fibres, then sensory fibres, And lastly the motor fibres.

B- Cardiovascular system:

-Fall of blood pressure and bradycardia due to paralysis of the sympathetic fibres from the thoracolumbar outflow, while the vagus nerve is left intact.

-If this fall of blood pressure is marked (more than 50% of its original level) the patient is considered to be in a state of spinal shock.

Treatment of spinal shock: support circulation and respiration i.e

1- O₂ inhalation

2- Trendelenburg position: to ensure adequate blood supply to central nervous system and improve venous return to the heart.

3- Vasoconstrictor drugs: To overcome the peripheral vasodilatation caused .by sympathetic shock, e.g.

-Epinephrine 30 mg LV. + 30 mg I.M. -Noreadrenaline drip 1/250000

4- I.V. fluid: blood, plasma or plasma substitutes.

C- Respiratory system:

By ascending paralysis, the intercostal muscles which are supplied by the thoracic nerves are paralysed.

If the local anaesthetic solution extends to the cervical region, paralysis of the phrenic nerve which supplies the diaphragm occurs. The patient may stop breathing so that respiratory support by IPPV and if necessary, tracheal intubation may be required.

D- Gastrointestinal tract:

Nausea and vomiting are common, perhaps because of the unopposed vagal tone or hypotension that decreases cerebral blood flow.

Anticholinergic medication or blood pressure elevation may be used to treat this side effect.

E- Metabolic and hormonal:

S.A.B. attenuates metabolic and hormonal stress responses to surgery; which are increase blood glucose, cortisol, catecholamines, ADH, rennin levels, and postoperative negative nitrogen balance.

Complications of Spinal Anesthesia

1- Total spinal:

It is a local anaesthetic depression of the cervical spinal cord and brain stem-includes dysphonia, dyspnea, upper extremity weakness, loss of consciousness, pupillary dilatation, hypotension, bradycardia and cardio pulmonary arrest.

Treatment includes securing the airway, +ve pressure ventilation, volume infusion & vasopressor support.

2- Postdural puncture headache:

Severe headache may develop after dural puncture, secondary to the vent in the dura and the resultant CSF leakage. This leads to traction on the intra cranial blood vessels and nerves.

Symptoms: characteristic headache that appears with raising the head and relieved by recumbency.

Treatment:

Prophylactic: The aim is to allow but minimal leakage of CSF as possible.

- a) By using the finest lumbar puncture needle.
- b) Patient lies in bed as long as possible with foot of bed raised.

Curative:

- a) Hydration (pushing of fluid).
- b) Many drugs have been used (e.g. analgesics, NSAIDs and narcotics).

3- Local anaesthetic toxicity:

Inadvertent intravascular injection of the local anaesthetics or excessive dose.

Prevention: correct technique, aspiration before injection, test dose and slow injection.

4- Hypotension:

Due to: • Total spinal block. • Vasovagal attack. • Anaphylactoid reaction. • Local anaesthetic toxicity.

5- Neurological complications:

- Neuritis.
- Adhesive arachnoidites.
- Meningitis and meningism.
- Haematoma and spinal cord compression.
- Abscess formation.

6- Urinary retention:

- Avoid over hydration.
- May need catheterization.

7- Equipment complications:

Spinal needle may break at the junction between needle and the hub.

Causes of death under spinal anaesthesia:

- 1- Spinal shock.
- 2- Respiratory paralysis.
- 3- Usually combined.